This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

GENERAL LIBRARY

OF

University of Michigan

Presented by

Hon. J. C. Burrows

Sept. 11, 1900

SD
211
.A56
1900

REPORT

ON

FORESTRY IN SWEDEN.

BY

GENERAL C. C. ANDREWS,
UNITED STATES MINISTER AT STOCKHOLM, 1869-1877.

(NEW AND REVISED EDITION.)

Printed by the Senate of the United States under the following resolution, which was introduced by Mr. Nelson December 11, 1899, referred to the Committee on Printing, and reported and adopted January 24, 1900:

"*Resolved*, That 20,000 copies of the report on forestry in Sweden, made to the Department of State by Gen. C. C. Andrews, late minister at Stockholm, be printed for the use of the Senate, the said report to be revised by the author.'

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1900.

REPORT ON FORESTRY IN SWEDEN.

INTRODUCTION.

My report on forestry in Sweden was originally published in the volume of Foreign Relations of the United States for 1872, and the then Secretary of State, Mr. Fish, also caused a separate edition of it in pamphlet form to be printed and distributed. The Senate having authorized a new edition to be revised by myself (without charge), I immediately consulted Count Wachtmeister, chief of the forestry bureau at Stockholm, as to any new matter that could properly be introduced. He replied that on account of changes that had occurred since my report was made it would be advisable for me to engage Mr. K. G. G. Norrling (extra jägmästare) to prepare a short complete sketch of the present situation of Swedish forestry, which I gladly did. Mr. Norrling is an educated and trained forester, eligible for appointment as chief of range, and has furnished a very able sketch in Swedish, a translation of which forms the fourth to the tenth of the following subdivisions, inclusive. The translation is not as concise as the original, but is the best that circumstances have permitted.

1. MR. ANDREWS TO MR. FISH.

No. 166.] LEGATION OF THE UNITED STATES,
Stockholm, August 5, 1872. (Received September 25.)

SIR: I have the honor to send herewith a report which I have prepared on the forests and forest culture of Sweden. It comprises a practical description of the manner of growing and the economical management and use of forests, as well as a translation of some of the principal laws on the administration, care, and preservation of public forests and for the support of instruction in forestry.

I also transmit four different treatises, in Swedish, on forest culture, cited in the report; also, a report of a commission in regard to further legislation concerning the forests.

The commission first mentioned recommend legislation in Sweden similar to what obtains in many other countries of Europe, prohibiting owners of private forests from cutting, for commercial purposes, trees under a certain size. The fact that some kinds of trees require several generations for their full development and that the climate and supply of water in a country are much influenced by the existence or nonexistence of forests affords strong grounds for such a law.

Trusting that this document may be of some help in shaping the much-needed legislation in the United States for promoting regrowth and the preservation of forests, I remain, etc.,

C. C. ANDREWS.

2. Nature and Extent of the Forests of Sweden.

The great mass of the forests of Sweden is found in the north central part of the country, and consists principally of the so-called Scotch pine and the white or Norway spruce, both of which grow to great size and are highly esteemed for their timber. The common European oak has its natural northern boundary along the river Dal, but is cultivated up to Sundsvall, in latitude 62° 20′. It is a splendid tree, a favorite ornament to parks, and produces timber superior to American white oak. The beech abounds in the south part of the kingdom, and is cultivated even north of Upsala. However, the species most numerous, next to the fir, is the white birch, which has a beautiful drooping foliage and is useful for timber. It is found in all the forests and is not unfrequently used for avenues at country seats. It furnishes the principal fuel. The lime, or linden, makes a handsome and vigorous tree, and it is not uncommon to see it forming splendid avenues a couple of centuries old. The gray alder is very common and merits particular notice on account of its large size. The elm (less stately than the American), the soft maple, the ash, the poplar, the hawthorn (oxel), large and handsome, are also common.

On the whole, Sweden appears to be a natural forest country. Nor is the climate unfavorable to a fair variety and hardy growth of trees. Observations at Stockholm, from 1754 to 1863—one hundred and nine years—show that the extreme of heat during that time was 96°.8, and the extreme of cold 25°.6 below zero, Fahrenheit. At Haparanda, the most northerly port, also in Jemptland, the mercury frequently freezes. [For some remarks on the fruit trees of Sweden, see report on the agriculture of Sweden, Commercial Relations United States, 1870, p. 385.

In 1850 the then chief director of the Forest Institute estimated the area of land in Sweden which bears, or is suitable for bearing, forests at 30,000,000 acres; and he expressed the opinion that if forest growing was properly attended to the country would not only have enough product therefrom for its own use, but a quantity for export, which, at the then increased price of lumber in southern countries, would be more profitable than the export of iron. He maintained, however, that forest economy up to that time had been managed with the greatest want of care.

Mr. Forsell, in a paper on this subject, published in 1844, shows that a lack of timber was beginning to be felt in many parts of Sweden, and states that Stora Kopparberg and Gefleborg were the only counties so rich in forests as to be sure of their preservation for a long term of years without an improved system of forest economy. And he adds that, if such a system shall not be established, the whole country will soon suffer for the want of forests.

As proof, however, of the efforts in this regard which were being adopted by the Forest Institute, as well as the iron office, it may be mentioned that on Wisings Island 700 acres were planted with oaks, the sand plains of Christianstad and Holland counties were planted with trees, and improvements were made in the royal parks.

At present one sees along the principal routes of travel a generous supply of forest, though the trees are mostly young; and the surface of the country, being agreeably undulating and abundantly supplied with clear streams and lakes, tends to produce a favorable impression. The growth of young forest on patches too rocky for tilling, or even grazing, and the scattered seed trees left standing in places where

wood or timber has been cut off in the larger forests, remind the traveler of the attention to forest culture which is becoming general.

3. Historical Sketch of Forest Administration.

Most of the countries of Europe, and Sweden among them, appear to have borrowed the principal part of their forest science from Germany, which has long occupied the foremost position in respect to forest administration and forest literature.

Forest regulations were issued by the Swedish Government as early as 1647; and even before that private owners were required by law to plant and protect from cattle two timber trees for every one cut—a crude practice, which to the educated forester is ridiculous, because to obtain good timber trees the forest when young must be crowded. The owners of privileged estates were exempted from this last requirement by the diet of 1734, but it continued to apply to tax-paying estates and to crown lands leased to private persons till 1789. Regulations for the forest were again issued in 1793, but they were soon found unsatisfactory, and in 1798 a commission was appointed, consisting of six persons, to devise new regulations, which, after five years' labor, reported an amendment of fifteen sections of the forest regulations, and their project was finally confirmed and issued in the form of forest regulations, August 1, 1805. The same day a royal circular letter was sent to each of the county or provincial governments, ordering a project to be presented for a law on the duty of replanting forests. Shortly afterwards Prof. F. W. Radloff was commissioned to visit Germany to study its forest system, and his report was submitted, in 1809, to the before-mentioned commission. The subject was, in 1810, remitted by the diet to the administration of marine affairs and the bureau of public or crown lands and of mines, which, after the provincial governors had expressed their opinion thereon, recommended (1819) that each county or provincial government should work out a plan adapted to its own locality, and that a committee for the whole kingdom might then be appointed to prepare a final project for a law on this subject. The matter was taken up in the cabinet in 1820, but was postponed till 1823, in order to be united with a law for the sale of crown timber; and the result was that regulations for the crown forests were issued by the Government in 1824. Early in 1828 a committee of three persons was appointed by the Government to report a project for the economy of public and private forests and amendments to the laws in regard to hunting. The committee reported the same year in favor of the establishment of a forest institute, to be located in the deer park, close to Stockholm, of suitable instruction in hunting, and the establishment of a central bureau or administration for the management of forest affairs. The Government established the institute and confirmed the plan for its operation. The committee, on further consideration, being of opinion that the administrative duties could be performed by the chief director of the institute, the Government postponed establishing the central bureau of administration, but charged the committee to prepare a new plan of instruction in regard to hunting and the management of forests. Report having been made as to the principles which should obtain therein, the committee was again, in 1836, ordered to report regulations in conformity with such principles for instruction in the forest and hunting establishment. Their projects were presented in 1837, and the Government issued an order embodying the same March 16, 1838.

Influenced by the action of the sixth Swedish national agricultural fair of 1853, no less than by that of the diet in 1853 and 1854, the Government appointed a committee to report a project as to what means, either through the legislative or executive branches of the Government, could further be adopted to obviate in the future the then complained of lack of forests and the injurious climatic effects arising from their destruction. Their report was handed in June 28, 1856, embracing a plan for the management of forests, and action thereon was taken in 1859, when the bureau of forest administration was created.

4. Area of State Forests.

The whole area of Sweden, water not included, contains 102,797,720 acres, of which 72,711,285 acres are uncultivated land (barren mountainous regions not included), and of this area, 47,500,000 acres, or 46 per cent, consist of forests. Among countries exporting wooden manufactures Sweden takes first place, both on account of the magnitude of the export and the excellent quality of the timber. The forests belong either to the State, to certain communities and public institutions, or to private individuals.

To the State belong:

	Acres.
Crown parks	9,354,404.20
Quicksand plantations	3,333.13
Undivided crown lands, etc	2,390,562.52
King's domains	483,177.05
Forests assigned for the maintenance of civil and ecclesiastical officers	902,486.23
Mine forests, etc	761,036.52
Total	13,894,999.65

Other public forests are:

	Acres.
Forests assigned to public institutions	129,666.77
Common woods belonging to certain communities	1,476,624.30
City forests	104,779.83
Forests of crown lands and plantations	2,821,172.70
Total	4,532,243.60

All these forests, containing in all 18,427,243.25 acres, are called public forests and are placed under the supervision of a separate department for the management of the forests. The greater part, or 12,500,000 acres, are under the exclusive control of this department.

The public forests contain about 25 per cent of all uncultivated land and the greatest part of the forests of Sweden is, therefore, under private ownership. The two northern provinces, Lapland and Westerbotten, extending between 64° 69′ north latitude, have the largest percentage of public forests, viz, 12,750,000 acres. But in all other provinces private forests predominate. There is a great desire to increase the public forests, as experience has clearly shown that owners of private forests always endeavor to get as early profit as possible by cutting the timber that is most easily sold, without thinking of the future need and common welfare. The Swedish Riksdag has looked into this matter thoroughly, and large sums are yearly devoted to the purchase of land in order to establish new crown parks.

5. Forest Administration.

The value of the forests and their great influence, both upon the climate and the fertility of the soil, is now understood by all intelligent

people in Sweden. The idea also prevails that the forests are threatened with destruction, if not the same special care is applied to them as to the cultivated soil. They have therefore been placed under systematic management. The forests are under the care of various officials—chiefs of range, managers, and foresters—and the State is doing all in its power to protect the forests by proper legislation. Large sums have been granted for their management, and nothing has been neglected in order to bring the forest economy into a true relation with other branches of agriculture.

From the above it may be seen that forest economy is of great importance, as mistakes in regard to the management will affect a long period, and at the same time it is hard, if not impossible, to remedy them. The State has, therefore, either at the universities or at special institutions provided for a theoretical education of forest officials. They receive the necessary practical instruction in the forest.

A competent forest manager ought to be a naturalist, a forest economist, and a man of business, all in one; he ought to be especially versed in natural history, forest legislation, building of roads and waterworks, and also in political economy. He must know the peculiarities and the developments of all different trees, mosses, and forest vegetation; he must be familiar with the quality of the soil in each part of his district; he must make observations in regard to nature's influence, if favorable or harmful, upon the growth of the forest; he must observe the winds, the precipitations, the drought and the frost, and the animal life, from the grazing beasts to the smallest insects. He must know the effects of all these different influences, so that means may be taken to protect the forests.

The proper method of managing forests has been investigated from time to time by special committees, from the forest committee of 1749 to the Norrland forest committee of 1868. The expected results have not yet been accomplished, and the question of the State's relation to private forest economy is yet an object for lively discussion.

In 1896 a committee was appointed to submit propositions for a better management of private forests, and the work of this committee was finished in 1899, although the results of its investigations have not yet been acted upon by the State authorities. It seems as if the idea now generally prevails that the preservation of the forests is necessary to the future welfare of the country. The forests must be better managed and cultivated; it is not sufficient to lessen the cutting of timber.

The later history of Swedish forest economy is intimately connected with the name of Israel Adolf af Ström. Having traveled extensively in Denmark and Germany in order to study the higher developed forestry of these countries, he made his experiences known through books and pamphlets, and he also used his personal influence to effect a better system of forest economy. He paved, indeed, the way for the later development of forestry in Sweden. The first result of his work was the establishment in 1828 of the State Forestry Institute in Stockholm, and the organization of the forestry corps (skogsstaten) in 1836. Ström had as early as 1823 established a private forestry school at his own expense. He died on the 24th of October, 1856.

The development from that time has not depended upon individual struggle, but upon the cooperative efforts of the forestry corps and the central forestry bureau (skogsstyrelsen). The latter was in existence between 1859 and 1882, and during these years Mr. C. A. T. Björkman (of late years governor of the province of Gefleborg) exercised a great influence upon all matters pertaining to forest economy

in Sweden. Reorganized in 1883 as the domain bureau ("domän styrelsen," literally domain administration), it has distinguished itself by adopting the newest ideas, not only in regard to educational work and firmer organization of the forestry corps, but also in regard to rational forest management, in which the system of tract cutting had formerly been treated with partiality. The perfection of the thinning system and propagation through methods of heredity and selection are, no doubt, the most powerful factors in bringing about a sounder and more lasting condition of the national forest economy of Sweden. But in order to reach such a development experiments are necessary, and these experiments must be made according to certain plans and continued until crowned with success. The results gained by these experiments are rather too expensive to be used in the practical economy of the forests, and it is, therefore, very probable that an experimental forestry station will be established in Sweden similar to institutions of this kind in the larger countries of Europe.

The domain bureau superintends not only the public forests, but also the state agricultural lands. It is under the control of the royal agricultural department. The forestry corps (skogsstaten) is under the domain bureau, and received its present organization in 1890.

The forests of Sweden are divided into nine districts (it is intended to later increase them to ten), and each of these districts is under the management of an inspector (öfverjägmästare), whose principal duty is to exercise control over his subordinate officers. He ranks with majors of the army and receives a salary of $1,400 a year besides traveling expenses. The districts are subdivided into "revir" or ranges, numbering eighty-eight in the whole country according to a granted increase in 1900. Each range (revir) is under the supervision of a chief of range (jägmästare—hunting master), whose duty is to take care of the public forests in his range and also (in certain parts of Sweden) to see that the laws in regard to private forests are observed. He ranks with captains of the army and receives a yearly salary of $1,200. He is aided in his duties by an assistant (extra jägmästare) and gamekeepers (kronojägare). The latter superintend certain tracts (bevakningstrakt) of the range.

Lapland and Westerbotten contain 33 ranges, each averaging 312,500 acres of public forests and 410,000 acres of private forests. The latter are also under the control of the forestry corps. In central Sweden (the remaining part of Nordland and Dalarne) each of the 17 ranges averages 150,000 acres of State forests, while of the private forests only 145,000 acres (located in Sarna and Idre revir) are under the control of the forestry corps. In southern Sweden (Gotland and Svealand except Dalarne) are 38 ranges, each averaging 47,500 acres of State forests and 6,250 acres of communal woods (härads allmänningar). In one range (the island of Gotland) the private forests containing 538,000 acres are to a certain extent placed under the control of the forestry corps. In the whole country the State forests average 166,250 acres in each range.

The duties of the forest officials are fixed by the royal instruction to the forestry corps of the 29th of November, 1889.

In exercising supervision over the range the proper officers must act in accordance with the royal regulations of the 26th of January, 1894, in regard to the economy of the public forests. As public forests are also considered the so-called communal woods (härads allmänningar) in southern Sweden, they are managed after the same methods as the State forests.

The most important law in regard to private forests is that of the 29th of June, 1866, about the right to dispose of the timber on certain lands for which ground rent is paid to the State (skattehemman) and which were originally new settlements (§ 4 and § 5 of this law are changed by the royal notifications of September 18, 1874, and of April 20, 1883). This law was originally intended only for such rental lands in upper Nordland which were separated from the Crown after June 29, 1866, or for such older settlements where the prescribed duties in regard to building and cultivation had not been fulfilled. But through § 8 of the royal regulation of May 30, 1873, in regard to the dividing of the grounds in the Lapland districts of Westerbotten and Norrbotten, this law was extended to all private forests in Lapland, the largest and most northern province of Sweden. Although this province contains many barren mountains, it comprises not less than 19 ranges. Through section 4 of the royal letter of June 27, 1879, in regard to the grounds for surveying and dividing Sarna parish by the Idre Chapell law, this ordinance of 1866 was extended to these parishes containing the most southern mountains and constituting each one range. This law is intended to limit the yearly output to a certain quantity of timber which the chief of range marks out for sale. It is therefore called "compulsory marking" (utsyningstvång).

No forest laws are in force for the mountainous regions between Lapland and Sarna parish. In Westerbotten, the next largest and the most northern of the coast provinces, containing 14 ranges, the private forests are subject to the royal ordinance of March 19, 1888, in regard to measures for preventing excessive cutting of younger trees in the districts of Vesterbotten and Norrbotten. This ordinance limits the amount of timber to be offered for sale to trees of a certain minimum size, and is, therefore, called "the dimension law." Only if smaller trees must be cut for the best interests of the forest the chief of range shall first mark these trees for sawing and shipping purposes. In the island of Gotland, constituting one range, all private forests are subjected to the law of March 30, 1894, about measures for preventing forest destruction in Gotland.

The aim of this law is not only to act as a dimension law, preventing the shipping of smaller trees, but also to cause voluntary forest cultivation made necessary by the lack of natural reproduction. After an investigation has been made by the chief of range the governor of the island is authorized to prohibit any timber to be cut for shipping purposes until new growth has been produced. In three southern ranges of Sweden similar regulations are prevailing in regard to 19 private quicksand plantations where cultures and markings shall be made by the chief of range.

The private forests above-mentioned subjected to different laws constitute about one-fourth of all private forests. How large a percentage of the remaining three-fourths that are managed more or less according to the principles of forest economy can not be stated, but it is a fact that at least a part of them are cared for by persons educated in forestry. Many of the private forests of Nordland have been acquired from their original owners by sawmill companies, and this has greatly hastened the utilization of the forests.

As a part of the official statistics of Sweden the domain bureau publishes a report every year of the forest conditions of the country during the preceding year. This report is based upon the annual reports which the inspectors and the chiefs of range are obliged to send to said bureau in regard to the management of their respective dis-

tricts and ranges. According to the report of the domain bureau of 1898 the assessed valuation of the Crown parks and similar state forests was $1.60 per acre.

The statistics of the same year show:

The income to the State from forestry		$2,104,412
Cost of management (for the forest economy)	$275,879	
Cost of administration (for the forestry corps)	135,146	
The forestry institutions	12,634	
		423,659
Net earnings		1,680,753

In the administration expenses is not included any part of the cost for the maintenance of the domain bureau, agricultural department, or the provincial governments, although they are all taking part, more or less, in the administration of forestry. In regard to private forests of Sweden, any certain values can not be given.

6. Different Systems of Forest Culture.

Thinning was originally the only method of cutting timber, and the cutting was done wherever it was convenient to do so without taking into consideration the condition of the trees left standing or the requirements for reforestation. The result was that the forests degenerated and became sparse. The cause was ascribed to the method of thinning, and instead of improving this method it was almost entirely abolished and tract cutting introduced. Many a forester would not afterwards accept any other method than the latter, which enabled him to estimate the future producing capacity with very great accuracy, to provide for forest reproduction, and also to see without difficulty the results of his work; but tract cutting violates nature, and as certain circumstances make the application of the method harmful to the forest's duration, the old method of thinning, although now greatly improved, has again been adopted. Often thinning has been adopted because of the rocky and poor quality of the soil. Such is the case with quicksand plantations on the seacoasts, where a method of thinning must be used, as it is important that the complete growth of the trees prevent the sand from becoming loose and drifting.

If a forester were accompanied on his inspection tour in the desolate forests of Norrland it would be seen that he also must employ a method of thinning, as only the large trees suitable for lumber can endure the long transportation and be in a fit condition to sell. Thinning is, therefore, necessary for the sake of economy, and forests, where this method is practiced, are called timber-thinning forests (timmerblädningsskogar).

Tract-cutting forests are divided into districts and smaller divisions according to the condition of the trees and the soil and a specified number of cuttings made, each of which is cut and replanted at the same time, so that in the future they may produce trees of the same age. In the beginning the new growth is very dense, so that thousands of plants are found on each acre, but soon many become crowded and die out. This clearing process continues with increasing force, and as soon as the plants have reached such size that they can be utilized for poles and sold, this natural-clearing process is aided by removing all damaged, ugly, and crowded trees, and this is repeated at certain intervals, usually every tenth or twentieth year. Assistance clearing,

the forester calls this operation, and he seeks thereby to hasten the development of the remaining trees. When reproduction is the result of seeding, and the forest is allowed to continue its growth until mature, about one hundred years or more, as is the case with the coniferous and some deciduous forests, they are called "high forests" (högskogar), whether the cutting is done by tract cutting or thinning.

During the last two decades the thinning system has again come into favor. It was at length seen that tract cutting was not conducive to protect the soil's power of reproduction, which is liable to deteriorate after the cutting has been completed, and it also brought with it considerable culture expenses. During the latter years it has also been observed that transplanted forests and also those raised by seeding are inferior to those reproduced by natural propagation. Seeds have been taken from parent trees, good or bad, without discrimination. Most of the seeds are grown in nurseries, and they often give the plants bad peculiarities which they have inherited. After the poorest have been thrown aside the others have been treated as normal plants and set out, as if they would all reach the same state of perfection. The natural selection has therefore been counteracted, and the result must be degeneracy. When thinning is now in progress, special attention is paid to a continual progressive selection. This is commenced in the young forests and is repeated after suitable intervals, the length of which depends upon different conditions and is greater in the northern parts. It is also used in middle-aged and older forests, reproduced by natural propagation, in groups, without the soil becoming exposed to the sun or the winds.

As thinning therefore protects the nourishment of the soil better than tract cutting and at the same time provides for reproduction without direct expense, it also produces a forest hardier against external dangers. Far from trying to produce tracts of trees of a uniform age, which are the tract cutter's pride and joy, the work is arranged so as to reproduce forests of the greatest possible difference in age. The forests are raised by propagation in groups, causing these groups of young trees, by cutting the larger trees on the borders, to extend until they at length join each other. Each group will, consequently, have the largest and highest trees in the center, and the trees will decrease in age and size toward the sides. This amphitheater order brings with it light, not only from above, as is the case in tract-cut forests, but also from the sides, by which a more rapid growth is secured. The power to resist the pressure of snowfalls and storms is thereby increased, and the danger of attacks from insects lessened. Thinning also allows each individual tree to exercise its right. The many slender trees which under the system of tract cutting are felled develop under thinning into trees that will furnish the finest timber. The cause of this is the exposure to more light, by which they acquire a more rapid growth.

There are many modifications of the thinning system. From the above-described method of thinning, tract thinning differs, especially in that respect, that in reproducing less attention is paid to a circular widening of the old openings than to continually making new ones. Another modification of thinning produces propagation first by a general thinning, and later on by a thinning, increased during a long time, of the so-called reproduction tract. The different methods of thinning are employed exclusively in the northern and central parts of Sweden, called Norrland and Dalarne, where two-thirds of all the forests in the country are located. Of the State forests, 90 per cent are

thinned, and of the private forests, 60 per cent. In the remaining forests of the country tract cutting prevails.

7. Forest Reproduction.

Propagation as applied to forestry means the continuance or multiplication of trees, either by nature or by human means, by which a new generation of trees is produced to succeed a forest wholly or in part destroyed. When trees are cut simply for lumber or other purely forest crops, care should be taken that a new crop may cover the part deforested. This should not be left to chance, but the greatest discrimination should be exercised, for there is reason to believe that the plants will inherit the peculiarities of the parent tree. Just how far this inheritance extends can not yet be stated, as relatively few experiments have been made with forest trees. The more noticeable among the peculiarities are the larch tree's inclination to grow a crooked trunk, the characteristic appearance of the pine tree's trunk and crown, the speedy growth of pine, spruce, and birch, the time for budding and shedding their leaves, etc. The results show that heredity is an important factor to be taken into consideration and that in many cases plants of crooked, knotty, stunted, and sickly trees will be liable to resemble the parent trees. Consequently only rapid-growing, healthy, handsome trees ought to be allowed to propagate our forests, so that they will not degenerate, but advance to an end toward which culture is striving—greater production and more valuable forms.

When, therefore, the soil that produces a tree of slow growth can nourish one of more rapid growth of the same species, wisdom counsels us to save only the best trees for the purpose of natural propagation or self-seeding. Of Swedish coniferous trees, only the pine can be left standing as single scattered trees when cutting is done, as the spruce so treated would either dry up or be overthrown by storms. The spruce forest ought, therefore, to be reproduced by thinning; but this thinning can not be done in old, dense spruce forests, as the trees would then be exposed to drought. The cutting must commence with middle-aged districts, and be repeated at short intervals, always cutting poorer and less perfect trees first, so that only beautiful and well-grown parent trees may contribute to propagation.

But even with the different methods of natural propagation, the forester must lend his aid wherever necessary. He must hoe or in some other manner loosen the earth, so that the falling seeds may sink into the soil and then grow as protected as possible. If a new growth fails to appear at the expiration of the usual time, longer time being allowed to higher latitudes and places of a higher level above the sea, new seeds must be sown or plants transplanted so as to raise more trees, for every year's delay only conduces to make the soil more dry and unfruitful. The requisite plants are often taken from places where the growth is denser than the welfare of the forest demands; but usually they have been sown and raised in nurseries, especially made for this purpose, where greater care can be expended on their development. The latter method of raising trees is best adapted to pine, spruce, and birch, but in certain instances is used to grow oak, larch, and other varieties.

In the southern part of the country, between 56° and 60° north latitude, where tract cutting is employed, many foresters prefer transplanting to seeding, as they consider the latter method less reliable.

Of coniferous trees, young plants from 1 to 5 years are used, generally 2 and 3 year pine plants and 2 to 4 year spruce plants. In transplanting great care must be taken that the roots may not become dry and that the least possible injury be done. The older the plants are that are to be transplanted the more carefully must they be removed, often letting a piece of earth remain around the roots. Planting in holes with the best porous soil is the proper way to guard against drought, which is the greatest hindrance to the advancement of culture. If planting in very poor soil, fertilized soil should be used in filling up the hole. Some foresters set several plants together; others censure, though often without reason, this method of planting, and set only single plants in each hole, carefully rejecting all plants not wholly perfect.

It is impossible to tell from the plant what the tree will be like, so that often after planting the result has been an ugly forest. The reason for this is unquestionably that the seeds did not come from beautiful trees.

The distance between each hole and the order in which they are arranged, differs very much. Usually the 2 to 4 year old plants are set in rows 1.5 to 2 m. apart, there being about 1.2 to 0.9 m. between each plant. In this way each plant receives about the same amount of space as if planted in square style at a distance of 1.3 m. or 1.7 to 1.8 m., by which 5,000 to 6,000 plants would be required for 2½ acres. When planting, the holes are usually made with a hoe and the plants set and planted with the hands. Care should be taken not to use implements that press the earth together and do violence to the roots.

In Sweden raising trees from seed is more common than transplanting. The ground is usually prepared in squares, and about 10 seeds sown into each square. The distance between these squares varies, but ought to be less than that between the holes made for plants. Eight thousand to 9,000 squares, with a surface of 2 to 3 square meters apiece for each 2½ acres, is considered the ordinary number for most districts. It is preferable to sow the seeds on the north side of and near stumps, stones, and other objects that give shade and protect from destruction by grazing cattle. This tree seeding occurs between 56° and 64° north latitude, but north of that it is rarely used.

In the public forests during 1898, through the forestry board, about 10,000 acres were cultivated at a direct expense of $2 per acre. What amount of this was planted and what amount seeded can not be definitely stated.

8. The Forest's Enemies. (Protection of the Forest.)

The care of the forest in Sweden consists principally in providing protection against its enemies, although for complete management are also included different kinds of underbrush, clearings, and thinnings. Such clearings are not now necessary to any great extent in the country's old forests, which have originated through natural propagation and are consequently not dense, but the now thirty-year old forests, which are partially or wholly the result of cultivation, will receive such care from a so-called stand culture.

In order to provide sufficient defense against storms, which in Sweden are the principal cause of injury to forests, the forester ascertains the direction of winds and strives to keep the part most exposed in a sound and dense growth. The northeast and southwest winds in Sweden are the most destructive, and in the interior of the country

also the direct western winds. When cutting timber it is therefore necessary to take the effect of the winds into consideration. The cutting ought to commence from a sheltered side and proceed toward the direction from which the wind comes with the greatest force.

Many varieties of tree plants must be protected from the frost. Such plants should not be raised in valleys which are conducive to frosts. The best protected places are those of a higher elevation than their surroundings, the colder and heavier layers of air settling in the lowest places. For certain tender varieties, to be distributed in northern parts of the country, warm, southern slopes with a somewhat dry and porous soil must be found. As a rule, places near marshes and swamps are more liable to frosts, and, besides, the surrounding woodland is so wet that forest vegetation on that account depreciates. The swampiness is increased by mosses which form the soil covering. In large territories, especially in Norrland, the ground is in this way in a state of increasing swampiness. The forest economist's duty is in such cases to change the vegetation at the same time that he cuts the timber. But where the woodland is so wet that the vegetation suffers therefrom, it should be drained by ditching.

One of the forest's enemies is fire. During dry summers forest fires were formerly quite frequent, but now rarely occur, and when they do are usually caused by lightning. Yet they can originate from very trivial things, such as carelessly extinguished camp fires in woods, and sometimes from sparks from a railroad engine. After a long drought it only needs a few sparks to fall among the dry brush and grass to ignite them, and the flames spread rapidly to the dry branches and the combustible stuff on the ground until the fire in a short time progresses with irresistible fury. The forest supervisor will then speedily call together as many people as possible, whose duty it is to immediately hasten to the place of the fire. If the fire is still confined to brush and grass, and if it covers only a limited area, the people are arranged on that side of the fire toward which the wind blows. While some with branches, which, if opportunity allows, have been dipped in water, sweep the burning mosses on the ground and strike against the fire to smother it, others are busy with hoes and spades scraping all combustible material on the ground in one long row, which to begin with is made only a few feet wide, but if there is sufficient time, wider.

If the earth is rich in roots and vegetable matter, or if after a steady drought the fire has penetrated into the mosses, a ditch must sometimes be dug. It is more difficult to control the fire when it prevails in the branches of the trees, which is a frequent occurrence in the resinous coniferous forests. Because of the heat and smoke it is then impossible to approach the fire, and means of defense must be on a larger scale. For such a fire a line of trees are cut at a suitable distance from the fire, letting the trees fall toward the fire. They are ignited and a counter fire started, the two then consuming everything in their way. From the strong draft caused by the larger fire the counter fires are drawn toward it. Still, the smaller fires must be closely watched, so that they do not spread in other directions. When the fires meet there is then no more food for the flames and the fires die out themselves. Deciduous trees in their leafy season exert a remarkable force in preventing the progress of forest fires, and the prudent forester lets belts of deciduous trees, which are also beneficial to coniferous trees in other respects, extend through his coniferous forests. It is true that the fire does not destroy the timber in

healthy trees, for only the resin, leaves, dry branches, and the bark, to a certain extent, become food for the flames; yet the trees themselves are so injured through this that they can not continue to grow and are felled. The yearly loss occasioned by forest fires is not large, but can not be definitely stated.

The forests' greatest enemies in the animal kingdom are its smallest ones, so far as the coniferous trees are concerned. The forest insects which, because of their insignificant size, are often overlooked by uninformed persons, do sometimes, when conditions have been especially favorable for their multiplication to enormous numbers, cause great ravages, and can then destroy not only extensive tree plantations but also whole forests. Among the insects which appear to have been most destructive in the Swedish forests, belong different species of beetles, such as bark-beetles, pine weevils, pine beetles, and caterpillars. The bark-beetles are called bark-beetles because they burrow into the bark of trees and deposit their eggs there, after which the larvæ themselves make burrows in different directions in the bark, in consequence of which the tree dies. The eight-toothed bark-beetle (*Tomicus typographus*) deserves special attention, as it attacks the spruce forests, and during years of ravages causes spruce drought on a large scale; also the twelve-toothed bark-beetle (*T. stenographus*), which usually prefers pine trees.

A very small bark beetle, the six-toothed (*T. chalcographus*), is often found together with the common eight-toothed beetle, and makes pretty star-shaped tunnels in the bark. The common pine weevil (*Hylobius abietis*) makes great havoc on coniferous plantations, but can, with some labor, be exterminated. The common pine beetle (*Hylesinus piniperda*), which at first sight much resembles the common bark beetle, is among the most widely spread of all the forest's injurious insects. Like the bark beetle, they live as larvæ in the bark of trees, and cause not a little harm when they become fully developed and devour the marrow of the youngest pine shoots, which thereafter dwindle away. They do not immediately kill the trees, but to a great extent retard their growth, and the top of the pines acquire a peculiar appearance, as if the side shoots had been cut off, and this is the reason the Germans have given this insect the name of gardener. The larvæ of the caterpillar destroy in the middle and southern parts of Sweden the roots of tree plants, and especially is this true of those in nurseries.

Among moths there are many which are injurious, such as the pine moth (*Gastropascha pini*), the black arches, nun or spruce moth (*Liparis monacha*), pine beauty (*Trachea piniperda*), the geometrical moth, bordered white moth or span worm (*Fidonia piniaria*), the larch mining moth (*Tinea la ricinella*), the pine-shoot tortrix or twig twister (*Tortrix buoliana*), the green oak tortrix or oak-leaf roller (*T. viridana*), etc. Among these the nun or spruce moth has advanced, devastating in southern Sweden, principally in Södermanland and Ostergotland, where elaborate means have been employed for their extermination. The work has been chiefly confined to whitewashing the trunks of trees, this procedure preventing the larvæ from infesting healthy trees. Besides, in districts small trees have been felled and the branches trimmed off, both to prevent the larvæ from spreading and to deprive them of food.

Too numerous game can also be harmful to the forest economy. Sweden's most noble wild animal, the elk, causes in certain parts of the country noticeable damage to young pines whose cones and shoots

furnish a part of his food. The roe deer causes injury to the plants of the spruce, and especially to those of the silver spruce. From the forester's point of view it would be well to reduce the number of these animals more than the hunter in the interests of hunting will admit. Even grazing cattle, and foremost among them the goat, become in places where propagation is in progress really injurious, especially if the pastures are not confined within certain limits.

To the forest's foes belong also a large number of parasitic fungi, which appear chiefly on the trees, blossoms, leaves, cones, bark, or else in the wood.

To the first group belong *Lopho dermium Pinastri*, which in nurseries cause much damage to two-year or older pine plants, fungi, *Chrysomyxa abietis* on the spruce, etc.

To the latter group of fungi, which produce decay, may be named the *Polyporus pini*, *P. annosus*, *P. pinicola*, *P. borealis*, all common on our coniferous trees. Against the parasitic fungi one is as yet almost defenseless. In many cases the diseased plants and trees must be removed to prevent the infection from spreading.

9. Preparing Plans for the Care of the Forest. (Forest Division.)

In rational forest economy the work which is to be done during a period of ten to twenty years is usually considered beforehand and special work defined for each year of this period. This calculation belongs to a part of forest economy called forest division or forest valuation. A careful plan of economy is mapped out for the management of the forest on the basis of a previous surveying, description, and estimate or valuation of the timber. But this plan of economy must often undergo more or less alternation, in consequence of unforeseen circumstances, such as storm devastations, insect depredations, and forest fires, or when it is necessary to make use of favorable conditions which may arise when there is an increased demand for certain varieties of timber. The changes in the original plans which thus arise are righted at the forest revisions recurring at regular intervals.

Complete plans for the care of the forest are usually made only in regard to the State forests, and not even in regard to all of these, as for the greater number of crown parks in northern Sweden only a summary is made of the valuation of the timber resources. A similar summary is also made of the timber to be cut during the so-called division period.

The cutting of the stated amount is then done without any previously defined plan, wherefore the succeeding revisions are intended not so much for pursuing a systematic forest culture already started as for making new calculations like the former ones. Such original calculation that is not intended for a certain period of time, but is only temporarily in force, is also practiced in regard to private forests located among the mountainous regions. These forests are under the supervision of the forest corps, and all timber cut for sale must be marked. For other private forests, which are subject to forest laws, no estimate is made of the timber to be cut, as the owner of the forest can conduct his lumbering to suit himself if he only remains within the wide limits of the law. The forestry corps has only to see that the laws are obeyed, and if they are not to begin proceedings in the manner already described under heading, Forestry Administration.

For the remaining private forests it is not customary to make working plans, although many of them—how many can not be stated—receive private attention from the forestry corps.

Directions concerning the division of the public forests for tract cutting and tract thinning were issued by the royal domain office May 16, 1896. According to these directions maps must be made of the forest, a general description of its nature and condition, and a special description of the different districts and tracts. A plan of economy with table, appendix, and memorial, containing propositions for the management and supervision of the forest and the disposal of the forest products, must also be made. In other words, a working plan is made.

The forest map is made on a scale of 1:8,000 by measuring in a great many lines, which, with the assistance of some already staked headlines, are measured off, with help of the compass, at 100 meters' distance from each other and traversing the whole forest. A change of that method is now under consideration in order to mark out, both on the map and in the forest, the permanent boundaries between the different tracts. The description is intended to form the foundation for the succeeding plan of economy, and shall include the result of the timber estimation, which is done either by districts or tracts, in cubic meters.

The plan of economy first defines the system of management and the rotation or the proper age of the forest trees. The age usually allowed to the two most common trees, pine and spruce, is about 100 years in the southern and not more than 150 years in the northern part. The time of rotation for the common birch found in pasture lands is from 60 to 80 years. The beech requires 120 to 140 years and the oak from 150 up to 300 years. Cutting or consumption is estimated according to the so-called compartment system introduced from Germany. To the plan of economy also belong directions for forest cultivation and drainage, building of roads, etc.

This forest division, carried into effect at the revisions and with a carefully pursued cultivation, creates a restocked forest of the greatest possible production for the future, but suffers the fault of giving, during the nearest periods, a very uneven present production.

In Sweden there are now (1900) no suitable regulations for divisions for thinning, but there is a passing from an old and obsolete method to a better one under which the foresters adapt their own various proposals. Lately the domain department has brought forth a project for regulating the division of public forests for systematic thinning. This proposition differs from the regulations for tract cutting now in force therein that the map of the forest is made on a scale of 1:20,000, that only trees which are disposable as timber are estimated in regard to number and cubic contents, and that the quantity of the yearly consumption is based on the amount of timber and the time of rotation, according to the future relation between the production and the amount of timber which is expected to exist in the forest after it has been thoroughly renewed and the production raised to its highest point.

When taking out the yearly timber production, the forester, as a rule, first removes the trees that have blown down and those which are dry or otherwise injured. Next of importance is to remove standing seed trees or other older trees which prevent the growth of the younger trees. The cutting must thereafter be extended to old woods which have become thin and sparse, and in their place new tracts

with a better growth must be established. The thinning may now begin in such young and middle-aged forests that are too dense, and last of all, the better and older forests are attacked in order to complete the yearly production. In mountainous regions and other districts where the forests are liable to suffer from storms, it is customary to let that part of the forest remain the longest which forms a kind of defense against the fury of the tempests. In other words, the cutting proceeds against the direction from which the storms come with the greatest violence.

When not all trees in an older forest shall be felled at the same time, the forest supervisor has each separate tree marked, the mark being placed both on the trunk and near the root or on a larger root branch, so that he can tell, after the cutting is over, whether other trees than those that were marked have been felled.

10. Utilization of the Forests. (Lumbering, etc.)

Lumbering is usually done by hired laborers under the supervision of a forester, and they are paid either by the day or by the piece as is the case when cutting cord wood, timber, beams, rafters, etc. When lumbering is done on a large scale the laborers are organized into crews and each crew employed on a certain tract which in Norrland is called "shifte," assigned for harvesting. After markings have been made for the participants of the community wood they usually see to their own lumbering. When sale of timber has been made in the larger public forests, the lumbering is almost always done under the charge of the buyer. Where forest economy is managed with care and on a large scale, it has been found prudent to employ permanent laborers who perform the lumbering and other forestry work, such as replanting, drainage, inclosures, etc.; they also assist in guarding the forest.

Winter is usually the time for lumbering, as there is then no agriculture in progress, and it is then most convenient to get the timber out of the woods. Not only is the supply of labor greater during the winter, but there are also other conditions making this time of the year the most suitable for lumbering.

During the winter, cones from coniferous trees (with the exception of the silver fir) should be picked, as this is naturally most easily done in places where trees have been felled. As wood for fuel ought to lie over at least one summer to dry, it is more profitable to cut one winter and to haul it away the next.

In the great forests, far from the haunts of men, from which come the immense lumber piles and timber stores that line the harbors of Norrland's seaports, and where a profound silence reigns during the summer, is such life and activity during the winter months as can scarcely be imagined unless one has witnessed it. A large number of men from the surrounding district are then busy at work cutting and hauling timber to the nearest landing. The laborers live in cabins (kojor) erected near the timber tract; for the horses, temporary stables are built.

In felling the trees, the laborer must see that the trees do not fall in such a direction that trees standing near may suffer therefrom, that as little wood as possible is lost in chips, and that the work progresses as rapidly as possible. When trees are felled with an ax, two incisions are made on opposite sides of the trunk, and about 2 per cent of the wood is lost in chips. This is one of the reasons

why crosscut saws are now commonly used both for felling the tree and for trimming. Even in northern Norrland the stumps are not allowed to be more than 2 or 3 decimeters in height.

The ax that the wood chopper uses to trim off the branches and to split the trees varies greatly in form in different districts. The one now commonly used is the American ax, the material of which is quite thin, but thicker toward the middle, so that the ax is less liable to fasten in the wood. The saws are also of different constructions. The two most widely used is the straight crosscut saw and the curved or crescent-shaped. The teeth of saws differ, however, greatly in their form and distance from each other.

The more difficult and consequently more expensive it is to haul the timber from the woods, the less value it has. A thoughtful forest owner will therefore endeavor to provide easy and suitable means of transportation, as he will in that manner raise the value of his timber to a considerable extent. To build good roads through the forests is one of the more important duties of the forest economist, and large sums have been expended for this purpose during the last years. In Norrland and Dalarne the forest roads can be dispensed with, as the snowy winters there make it both cheaper and more convenient to make only temporary so-called winter roads leading directly from the cutting places to the landing stations. Many millions have been expended in the northern provinces for the clearing of the rivers in order to make the floating of the timber more easy. In the State forests in southern and central Sweden much work has been devoted to road building.

Floating, however, constitutes the most important way of transporting timber. Without driveways it would be impossible to make the vast forests of northern Sweden available. After the timber has been hauled, during the winter, to the nearest stream on which floating can be accomplished, the logs are measured in regard to thickness and length and provided with the owner's mark, whereafter the floating begins with the spring flood. The timber is then brought through dams, canals, smaller waters that have been cleared, smaller lakes, etc., down to a larger body of water or a river to which, in this manner, many different rafts of logs have been floated through other water courses which empty therein. Thousands of logs float farther down the river until they are caught in a boom, where they are sorted according to their marks and brought to the adjacent sawmills or fastened together into different rafts to be further transported over larger waters. In the rivers, which are cleared and provided with different kinds of constructions, the logs are usually allowed to float separately, but much work is necessary before they all reach their places of destination.

The driveways are divided into districts, and these are subdivided into "shifts" or tracts, and in these certain persons are appointed whose duty it is to put out into the water all logs that float to the shore. When the logs get stuck in a waterfall or obstructed in some other manner and form a log jam, the men must hurry out to break the jam, although there may be danger to life. The men are under the supervision of "floating foremen," and the latter under a floating chief. By knocking and scraping against each other the logs are damaged in the ends, and therefore about 30 cubic meters are allowed on each log when the final transaction is made.

The total export of wood products from Sweden in 1897 amounted to $97,662,700. Of this amount more than half, or $49,153,356 was

received for exported wooden wares, which, therefore, in regard to value, form the chief export. Of raw material exported, boards and planks amounted to $34,946,000, beams and rafters to $1,081,000, ship timber, masts, etc., to $1,080,000, and pit props to nearly $1,865,000. Of manufactured wooden ware, wood pulp was exported to a value of $6,000,000, turners' and carpenters' finished products to a value of $2,081,000, and matches to a value of about $1,811,000.

The export has increased to a great extent, especially in regard to boards and planks, as can be seen by a comparison between 1871 and 1897. During the former year the value of the export of these articles was only $12,216,000, while in 1897 it amounted to nearly $35,000,000.

The cubic bulk of timber which brings this income amounts in round numbers to 7,000,000 cubic meters of raw material and 1,200,000 cubic meters of manufactured wooden ware. While the largest part of the exported raw material is composed of coarser and relatively dearer dimensions, the largest part of the raw material exported is less expensive material (pulp wood, staves, etc.). Similar timber enters also largely into export articles not classed as wood products, such as paper, pasteboard, etc. The amount of paper, pasteboard, etc., made from wood pulp is considerable.

The wood-pulp industry of Sweden consumes nearly 2,000,000 cubic meters of raw material. To the amount of wood charcoal that is used for mining purposes the woods contribute 4,500,000 cubic meters. But the very largest amount is used for the country's own needs as fuel, buildings, fences, glass works and brickyards, railroad ties, telegraph poles, boats, etc. More than 28,000,000 cubic meters of timber are at the present time taken from the Swedish forests every year, which is generally considered more than can be cut without lessening the forest capital itself, which nevertheless is far from being as great as would be required if all forest-bearing land yielded its greatest possible production.

11. LAW PROMULGATED JUNE 29, 1866, REGULATING FOREST CONSUMPTION ON LANDS LEASED BY THE STATE IN THE PROVINCES OF NORRLAND AND KOPPARBERG, AND STILL IN FORCE.

1. On lands in the provinces of Norrland and Kopparberg, of which hereafter the Crown may grant a lease the owner shall have no other right to the forest of the estate than to take sufficient timber and fuel for household purposes, without survey; and after survey and marking by the Crown officers, to appropriate and sell all that, in addition thereto, may be felled without injury to the forest. Neither may, for the purpose of cultivating the soil, the forest be felled otherwise than above is indicated, unless the owner, as hereafter stated, has obtained special permission thereto from the governor of the province.

2. What is prescribed in the foregoing section for estates arising from settlements on which the Crown may hereafter grant a lease shall also be in force for such estates arising from settlements on which lease already has been granted, and where the prescribed duties of building and cultivating have not been fulfilled within the time specified; and our respective governors of the provinces shall, in order to ascertain whether such is the case or not, as soon as convenient, and at least within the time when, according to existing rules heretofore, settlements ought to be inspected, order an inspection to be held in the order prescribed, at such settlements on which the Crown

has granted the lease, before the issuing of the regulations, and the accord hereof to be transmitted to our governor of the province. Should at any settlement the prescribed duties of cultivating and building not have been fulfilled within the time heretofore specified, our governor of the province shall, by a special resolution, from which appeal may be made in usual order, and where there can be no question of dispossession, declare that, since the settlement, when the duties of building aud cultivating have been fulfilled at some future period, the owner will only have such right to the forest as is stated in § 1.

3. It shall be specially stated in all the resolutions by which a settlement is transferred under the title of "skattehemman," or copyhold estate, whether the owner shall have full right to the forest belonging to the same or only enjoy the limited right mentioned in § 1; this ought to be recorded in the ground-rent book.

4. Any owner of copyhold estate mentioned in § § 1 and 2 who shall infringe the right to the forest of the estate given him by this law will be punished as for unlawful felling of forest, as per the twenty-fourth chapter of the penal law. The officers of the forest corps, as well as the foresters, shall be entitled to prefer charges against such offenders, and to seize unlawfully felled timber. The party who makes the seizure shall receive 20 per cent; the balance shall go to the forest-planting funds.

12. Forestry Instruction.

The principal institution in Sweden for instruction in forestry is the Royal Forest Institute, at Stockholm. It is pleasantly situated on a rise of ground in a grove close to the bridge as one turns from the city to enter the Deer Park. The course of study occupies two years. Tuition is free. Candidates for admission must have sound health, be neither under 18 nor over 28 years of age, and must have passed an examination such as admits to the university, which includes a knowledge of the German language and either the English or French. Among the studies pursued are the classification and division of forest, forest culture, and the quality of timber, forest technology, climate and soil, forest botany, forest insects, art of hunting, mathematics, forest and game laws, map drawing, etc. Four pupils receive from the State a stipend, as assistance, of 250 rix-dollars each, per year. Graduates are regarded as members of the forest "stat" or corps, and are in the line of promotion therein; their first appointment being that of assistant chief of range, which is generally received immediately after graduation and opens the way to their earning about 600 rix-dollars a year in surveying and other work connected with forest. In ten years they can be promoted to "Jägmästare," or chief of range. Above this last office is the position of forest inspector, which has been created for three or four years. Fifteen thousand three hundred rix-dollars are annually appropriated for the support of the institute. There are four active instructors, namely, the director and three "lektors" or teachers.

Besides the institute there are, in Sweden, six forest schools which are principally supported by the Government and located at the following places; Tierps, Upsala County; Ombergs, Östergötland County; Böda, Calma County; Daniels Lands, Christianstad County; Hunneberg, Elfsborg County, aud Silbre, Wester Norrland County. Tuition at the forest schools is free, and, besides, ten pupils at each school receive board and lodging free. The course of study lasts eight

months. Some knowledge of the common branches taught in the folk-schools is all that is required for admittance. A graduate of a forest school can be employed as a forest watchman at about 300 rix-dollars per year and use of a dwelling and patch of ground.

THE FOREST INSTITUTE—ITS OBJECT AND ORGANIZATION.

[Regulations issued May 25, 1860.]

1. A suitable locality in the royal park, near Stockholm, shall continue to be placed at the disposal of the Forest Institute, embracing lecture-rooms, library, rooms for collections, the director, one teacher, and one porter, also necessary ground for nursery, tree planting, and target ground; a suitable forest in the vicinity of the city shall also be placed under the regular care and management of the institute, in order to impart to the pupils practical knowledge herein.

2. In order to teach the pupils surveying, appraisement, and the technical terms of the forest, they shall, during a certain time every year, be employed in forests suitable for the purpose, under the direction of the teachers; separate funds will be assigned for this purpose.

3. To assist the pupils during their stay at the institute, a certain number of stipends, the amount of which will be separately fixed, will be assigned to such indigent pupils who have made themselves deserving of the same through industry, skill, and good conduct.

4. The institute is to be managed by a director, appointed by His Royal Majesty, and the director, together with four teachers, also appointed by His Royal Majesty, will furnish the instruction, viz: One the care and management of forests, one hunting and forest laws, one natural history, and one mathematics. These teachers will be entitled to their years of service, as merits equal to the forest and chase officers of the kingdom, the two latter only in case they have graduated at the Forest Institute. For the appointing of director, as well as teachers, the forest administration will nominate candidates. At the institute is also a porter, appointed by the director, and may by him be removed.

5. The course of instruction shall embrace mathematics and natural history to the extent required for the superintendence of forests and the chase; knowledge of the regulations for the forest and the chase, bookkeeping, and of the forms for forest accounts; hunting; theoretical and practical knowledge of forest appraisement; cultivation of woods and forest technology; as well as expertness in surveying, map drawing, leveling, and shooting.

6. The course of instruction will be continued during two years, counted from the commencement of the month of June every year, and be so arranged that fully-educated pupils may yearly graduate and new ones be admitted in their place.

7. Pupils who wish to obtain certificates of having graduated shall, having previously undergone a probation at a public examination, manifest sufficient knowledge and skill in all the branches which they have been taught at the institute. In order to obtain a certificate for forest management, the pupil shall prove himself to have satisfactorily constructed a map, with regular plan of forest surveying and cultivation.

8. The instruction shall continue during the whole year, with the exception of three weeks' vacation during Christmas and one week after the yearly examination, and shall be thus regulated, that the

pupils acquire, from the commencement of October until the end of May, theoretical and such practical knowledge as local circumstances at the institute admit of, and that during the summer months the pupils are occupied in the forests of the Government and under the direction of the teachers with surveying and estimating of forests, and with the most usual modes of the cultivation, care, and felling of trees.

9. Every year, at the commencement of the month of June, the pupils shall be publicly examined in all the subjects in which they have received instruction. The pupil who, having previously undergone a probation, proves himself at the examination to possess the knowledge and skill mentioned in § 7, may, without regard to the longer or shorter time he has been at the college, receive due certificate.

THE DIRECTOR OF THE FOREST INSTITUTE.

10. The director ought to have made himself known as possessing knowledge and experience of forest-managing, and shall live within the locality of the institute, in order to properly exercise his functions. His duties shall embrace not only the administration of the institute and the responsibility of its operations, and of the completeness of the instruction, but also to promote the development of and spread throughout the country the science of forest-management.

It shall consequently be the duty of the director—

(1) To quarterly collect from the treasury of His Royal Majesty and the realm, at the request of the forest administration, the funds assigned to salaries and maintenance of the institute; to dispose of these funds according to regulations, and for each calendar year account for their disposal, which accounts shall be delivered before the end of the next following February to the forest administration for auditing;

(2) To watch over the care and maintenance of the ground, buildings, nurseries, archives, library, collections, tools, implements, and other movables of the institute, and to see to it that complete lists of the same are made out and always at hand. He shall, however, according to what is stated below, have right to suitably distribute between the teachers the administration and care of collections, tools, and the movables;

(3) Having examined the certificates produced and the amount of knowledge possessed by the candidates for admission to admit them as pupils, and, according to statements of the teachers, separately for each branch, issue certificates to pupils who have finished their course, and to propose to the forest administration the distribution of the assigned stipends among such pupils who shall be considered most deserving of the same;

(4) To issue regulations as well for the maintenance of good order and morality within the institute as for the suitable course of teaching and the manner of imparting the same, for which purpose the director shall make out a regular table of instruction, so that the business be properly distributed between the teachers, and the time advantageously employed to the benefit of the pupils;

(5) To himself instruct in one of the head branches of forest economy as well as, business permitting, be present at the preliminary examination of the pupils in the other branches;

(6) To endeavor in every possible manner to promote the knowledge and spread of an improved forest economy and management of the

chase within the kingdom, for the purpose of which he must keep himself informed of the progress of the science and technical terms of the forest, even in foreign countries, and to write and publish pamphlets on the subject whenever circumstances require;

(7) To report to the forest administration partly such business which requires the decision of His Royal Majesty, and partly such steps in regard to an improved forest economy and management of the chase within the kingdom which may be found necessary;

(8) To make such reports or give such information concerning the forest economy and the management of the chase which the forest administration may demand, as well as to render to the same yearly accounts of the operations of the institute; and

(9) To give the porter instructions in regard to his attendance and other duties at the institute.

THE TEACHERS AT THE FOREST INSTITUTE.

11. The teacher of forest economy ought to have graduated at the institute with honors, and thereafter, on his own responsibility, managed a forest district, and, as his services are constantly required, he ought to live within the institute. This teacher shall—

(1) Instruct and examine in all the branches of forest economy in which the director himself does not teach; and, besides, practically instruct the pupils in surveying and estimating of the area of forests, and the cubic contents of trees, construction of maps, valuation of soil, growing and felled timber, to collect and preserve seeds, the laying-out and care of nurseries, forest growing and planting, the position of seed-trees, clearing, to quench quicksand, felling of trees, assorting and marking of timber, as well as to conduct a party of the pupils in the forests for practical measuring, estimating, and dividing of forest land;

(2) To have under his care, and to account for, the archives, library, and movables of the institute, with the exception of those for which the teacher of the chase and regulations is responsible;

(3) To manage the economy of and account for the forests assigned to the care of the institute;

(4) To assist the director in watching over that given instructions are followed, and in maintaining industry and order among the pupils; and

(5) To take command of the place in the absence of the director.

12. The teacher of the chase and regulations shall have graduated at the institute with honors, and thereafter served at the forest and chase corps of the Kingdom. This teacher shall—

(1) Instruct and examine in the knowledge of firearms, shooting, the theory and technical terms of the chase, forest and chase regulations, and bookkeeping;

(2) Assist at the practices in forest economy, and conduct, during the summer season, a party of the pupils on practical measuring, estimating, and dividing of forest land;

(3) To exercise the pupils in target practice, and also, when there is an opportunity of hunting and driving game, instruct the pupils in the care of wolf-pits, traps, nets, and cages; the making and care of hunting implements, the keeping of forests, as well as to prefer charges against poachers and other offenders against game and forest laws; and

(4) To take care of and account for the tools and collections of models

of the institute, as well as of the forest and hunting implements, and of what belongs to the target-ground.

13. The teacher of natural history ought to have made himself known as thoroughly well acquainted with this science. His duties shall be—

(1) To instruct and examine in those parts of physics, chemistry, and mineralogy which are required for the knowledge of forest climate and soil, in general and forest botany, and in zoology, as far as this branch of knowledge is connected with the forests;

(2) To instruct in the manner of preparing herbaria, and of stuffing and preserving animals and insects;

(3) To conduct the pupils on mineralogical and botanical excursions, and to practice with them the examining of soil and plants;

(4) To instruct the pupils during visits to the museum of the Academy of Sciences; and

(5) To take care of and account for the zoological and botanical collections of the institute, and to make out complete lists of the same.

14. The teacher of mathematics ought to have made himself known as thoroughly acquainted with this science. This teacher shall instruct and examine in arithmetic, algebra, planimetry, stereometry, trigonometry, conical sections, geometrical constructions, descriptive geometry, general and forest architecture, elements of mechanics, and theory of the construction and use of mathematical instruments. He shall besides practice with the pupils the drawing and copying of maps, calculating of areas, sketching maps, surveying, construction of buildings and roads for forest purposes, with estimates of materials and labor, measuring of cubic contents, and adjustment of instruments. [There are at present six teachers in the institute.]

PUPILS AT THE FOREST INSTITUTE.

15. In order to be admitted at the forest institute application shall be made to the director within the middle of the month of May [now before the 1st of July] and the following certificates annexed to the same:

That the applicant is at least 18 and not above 28 years old; that his constitution is good and faultless, and not affected with any kind of incurable disease; that he has always conducted himself well; that he either has passed such examination and obtained certificates of approval in mathematics, natural history, and Swedish grammar, which entitles him to enter the universities of the Kingdom, or that he has been examined by the appointed teachers at any of the elementary schools within the Kingdom in each of these branches, and found to possess sufficient knowledge therein to enable him to graduate from the school; also, that he has, during at least one year, with some forester practiced and acquired sufficient skill in the economy and surveying of the forest.

16. Applicants whose applications are complete, and who consequently may expect to fill the vacancies at the institute, must publicly and in the presence of the director be examined by the teachers in arithmetic and algebra, planimetry and stereometry, general botanies, and zoology; also, to write a Swedish theme.

17. Those exhibiting the greatest knowledge shall have the preference of being admitted to the institute.

18. At the commencement of every year the director shall propose to the forest administration for receiving of stipends those of the

pupils who are in need of assistance and have shown themselves most deserving of same through industry, skill, and orderly conduct.

19. The pupils shall obey the orders of the director and the teachers, orderly and decently conduct themselves, follow the regulations at the institute, and attentively and industriously profit by the instructions.

20. Should the pupil disobey the orders of the director or the teachers, create any disturbance at the institute, conduct himself in a disorderly manner, or neglect his studies, he shall receive warning from the director. Should he not then change his conduct, but continue his offenses, the director shall, after having consulted the teachers, send him away from the institute. [There are now a higher and lower course at the institute. For admission to the higher course applicant must have graduated at the forest school, Omsberg.]

THE FOREST SCHOOLS—THEIR OBJECT AND ORGANIZATION.

21. Suitable localities, large enough to permit both teachers and pupils to live there, shall be placed to the disposal of the forest schools at such places as will be especially determined upon.

22. To a certain number of pupils, unable to maintain themselves at the school, sufficient assistance shall be given, according to what is therefor specially prescribed.

23. The forest schools shall be managed, under the superintendence of the nearest chief of range, by a teacher appointed by His Royal Majesty the King, after having been proposed to the situation by the governor of the province and with the approval of the forest administration; this teacher shall be assisted by a ranger, nominated by the forest administration.

24. The instruction at the forest school shall embrace the four first rules of arithmetic and the rules of proportion in whole and decimal numbers; knowledge of scales for plan drawings, as far as required for making of maps and measuring distances; knowledge of square and cubic measures with practical application at the measuring of the extent and contents of surfaces and solid bodies; knowledge of the nourishing organs of the forest trees and of their food and the natural conditions for their thriving; knowledge of the most dangerous insects of the Swedish forest and of the manner of destroying them; the chief principles of rational forest economy, and knowledge of the rules existing for the peace and keeping of forests, marking and carrying of timber, hunting, and also of the legal form for entering charges. The pupils will also be practiced in marking out and measuring of forest lines; tilling places and sowing fields; calculating of the cubic contents of trees and timber; the position of seed trees; sowing by hand and planting, as well as the preparing of the soil for forest growing; collecting and assorting of forest seeds; clearing and cutting, assorting, and piling of timber; marking cattle and making out of grazing lists; laying up and keeping patrol lists; making out lists of unlawfully felled timber on which embargo has been laid; monthly reports and service accounts; the trapping of beasts, and the grand chase.

25. The course of instruction shall begin on the 1st of October every year and continue until the middle of the following June, during which time all the respective subjects and exercises shall have been taught to the pupils, whereafter they are publicly examined in the presence of the chief of range in order to ascertain the knowledge and skill they have acquired.

26. The pupil who has satisfactorily passed the examination is entitled to receive certificate of approved skill, issued by the chief of range and the principal of the school.

THE TEACHER OF THE SCHOOL.

27. For the competency as teacher at the forest school, which office entitles him to count as many years of service within the forest and chase corps, the applicant shall have graduated at the forest institute and received certificate of approved knowledge, besides having been forest manager on his own responsibility. This teacher is the chief in command at the place, the principal of the school, and accounts for and is responsible for the proper management of the school. He shall, consequently, quarterly receive the funds assigned to the school, use them with judgment, and yearly account for the same, which account shall, within the time specified in § 10, sec. 1, for the forest institute and for the object mentioned in the said section, be forwarded to the forest administration through the governor of the province. It shall, besides, be his duty to arrange the teaching and exercises to the benefit of the pupils; to keep good order and decent conduct within the school; to impart himself the theoretical knowledge, and to superintend and correct the exercises and work in the forest. He shall also render yearly report over the operations of the school, which is forwarded to the forest administration through the governor of the province.

THE ASSISTANT.

28. The assistant must have made himself known as steady and orderly, to be able to write, and well acquainted with all kind of forest works. He is subordinate to the direct command of the teacher; he has the care of all the implements and materials of the school, for which he is responsible and shall account for to the teacher; manages the school in the absence of the teacher, and is responsible that the exercises and works are properly done, and assists in keeping good order among the pupils.

THE PUPILS OF THE FOREST SCHOOL.

29. Those wishing to be admitted to the forest school shall make their application to the principal in their own handwriting, with annexed respective certificate of a clergyman, of good conduct, and of good and faultless bodily constitution, and if the applicant has been in service, a service certificate; the applicant shall be able to read fluently Swedish and Latin letters and writing, write a legible hand, know the first four rules of arithmetic, and be from 20 to 30 years old.

30. Having examined the applications and the applicants, the principal of the school shall admit as pupils the most skillful and of best conduct.

31. The pupils shall obey the orders of the teacher and assistant, and observe industry, order, and good conduct. Should the pupil disobey the teacher or the assistant, disobey the rules of the school, be neglectful or disorderly in his conduct, or should he create disturbance, he shall receive warning of the principal; should he not then change his conduct but continue his offenses, the principal shall send him away from the school.

PRIVATE FOREST INSTRUCTION.

32. For the establishing of forest schools in the respective provinces of the kingdom, and the education of competent assistants for managing private forests, the Government will, yearly, contribute as far as the funds will permit, provided the communities which apply for such assistance shall fulfill the following conditions:

(1) That the community shall place requisite locality to the disposal of the school, furnish the teacher as well as the pupils with apartments, and pay for the maintenance of the school;

(2) That the organization of the school and the proposed rules for its operation has been sanctioned by His Royal Majesty; and

(3) That the operations of the school, of which a yearly report shall be made to the forest administration, shall be exercised under the superintendence of the nearest chief of range and the forest administration.

13. REGULATIONS FOR THE DIVISION OF THE PUBLIC FORESTS FOR THE PURPOSE OF SYSTEMATIC ECONOMY.

[Issued June 29, 1867. Drawn up by Mr. C. A. T. Björkman.]

1. The dividing of a forest consists in its delination on a map with description and economical plan based on careful estimates having a view to the future of the forest and the highest reasonable income that can be derived from it.

2. The allotting is effected so that there may be introduced, as circumstances require, high-forest culture with tract cutting or systematic thinning, or, nevertheless, for applying low-forest culture.

3. Forest is divided, according to its extent and nature, into more or less blocks. Smaller forests however may each comprise only a single block. The block is divided into divisions or parcels, whose limits are generally determined by natural formation or permanent marks, and these again into subdivisions, including differences which have been observed in surveying, delineating, and estimating the forest.

4. In the surveying is noted only such differences of the forest stand and grounds as, according to the above-mentioned method of forest work, exercise some influence thereon; and with the objects and differences noted at the surveying shall be added on the map the boundaries exactly to correspond with the facts. When a correct map happens to have been previously drawn up, a copy of it, with requisite additions, shall be used in the allotment of the forest.

5. The map of the forest shall be drawn up on such scale as allows requisite clearness in specifying what should be noted thereon for the economy of the forest.

6. The forest is estimated in cubic feet or in cords of 100 cubic feet (Swedish) solid measure, except when the allotment or dividing takes place for thinning (applicable to heavy timber), when the estimate is made by number or piece. The estimate ought, as near as possible, to correspond with the reality, but had better be too low than too high.

7. The description shall include all important matters which, at the execution of the allotment, can be of weight for the economy of the forest.

8. The plan of management is drawn up for a period of twenty years and ought to include the requisite prescriptions as to the manner of working the forest, rotation time, consumption, culture, and the other

means of administration which have not already been prescribed by the public statutes.

9. Tract cutting will have the preference, as a manner of working the forest, except where from local circumstances it is unsuitable.

10. The rotation period should be extended as far as is necessary for raising the different sorts of trees and forest production which are counted on from the forest, but without occasioning such delay in consumption that any part of the forest shall thereby receive injury or deteriorate in value.

11. The estimate of what shall be consumed during the period of division or allotment shall be based on the forest's growth, the extent of ground, and on the known quantity of wood and timber, ascertained by careful calculation, whereof no more may be taken out than corresponds with the growth of the forest during the said time.

12. During the last year of the division period a revision is made for searching out the changes the forest has undergone and for drawing up the economy plan for the following division period.

Moreover, the Government having authorized the administration of forests to issue regulations which may be required in conformity with the above principles, the administration of forests has found it reasonable to ordain as follows:

1. The method of working a forest, mentioned in paragraph 2, above, can, where necessary, be introduced on the same block, though on separate parts thereof; for example, forest-grown rocky hills, moss tracts, or other land on which systematic thinning seems an object, also such tracts as seem suitable for low-forest culture, may enter into the same plan of economy with tract cutting, where the grounds have not sufficient extent for more than one block.

2. In dividing the forests into blocks, regard is had that as far as possible the older, middle-aged, and young forest stands are in suitable relations to each other, also that the block obtains a proper form. The ground allotted in the block for tract cutting may not exceed "6,000 quadrat ref" (1,306 acres). With the introducing of systematic heavy-timber thinning, block allotment is fixed according to the means for floating, and accordingly a connected forest of even 12,000 acres may be reckoned to a block, providing the product therefrom can be floated on the same water course. Lands whereon low-forest culture is introduced, and which are not entered in the economy plan that has been fixed for tract cutting are divided into blocks of at most 120 acres. When blocks are not situated apart, they ought to have natural boundaries, as water courses, marsh, and rocky-hill extents, etc., or nevertheless be bounded by highways or fences; but if such do not exist, they are separated by means of a line cleared through the forest to the width of 20 feet.

3. In dividing the block into parcels or divisions, the principal object of which is to facilitate "orienting" or astronomical directions, and clearness in description, likewise attaining an approximating homogeneous stand, the same is to be observed concerning their boundaries that has just been mentioned in respect to blocks. Nevertheless the separating lines may be cleared only the width of 10 feet. The forest land of a division should not exceed 200 acres, except in forests which are allotted for merchantable or heavy timber, within which, as comprising the division or parcel, may be reckoned only those parts divided by natural boundaries. Connected forest blocks of 200 acres extent or less constitute only a division or parcel.

4. The surveying of a forest, where it is so required, may be based,

as heretofore, on parallel lines running in right angles, or over valleys and summit extents in oblique direction. Nevertheless hereafter these lines ought not to be cut or cleared more than is necessary for making them visible, but shall instead be blazed to a breadth of 10 feet. In the allotment of the forest for the purpose of systematic heavy-timber thinning, smaller impediments, unless sketched on the map, shall only be noted in the description.

5. Forest maps shall be drawn up on a scale of $\frac{1}{8000}$ of natural size, with these exceptions: Lands allotted for heavy-timber thinning shall be mapped on a scale of $\frac{1}{20000}$ of natural size; lands for low-forest culture, according to separate plan of economy, shall be mapped on a scale of $\frac{1}{4000}$ of natural size. A separate map is drawn up for each block. On the just-mentioned maps of $\frac{1}{20000}$ scale two or three blocks may, nevertheless, be contained, according to circumstances. When the forest is composed of several blocks, with map for each, a comprehensive map of the whole forest may be prepared, showing the relative situation of the blocks, on a scale of $\frac{1}{20000}$ of natural size; and with heavy-timber thinning $\frac{1}{40000}$ of natural size. The map of the floating courses, below mentioned, are drawn on a scale of $\frac{1}{50000}$ of natural size. When a comprehensive map on the scale aforementioned has been prepared, the floating courses should be shown thereon, and in such case no separate map of these is needed. The maps shall be well and plainly drawn, colored, provided with names of bordering estates, forests, or the like, written around, title, scale, and north direction whereon the variation is observed. The cleared or blazed lines and the separating lines pertaining to the project for period allotment or division shall be drawn on the map; also the yearly clearing or cutting bounds in the first period; the latter, nevertheless, only on maps of forests which are not under the immediate administration of the forest corps.

6. The valuation or estimate of the forest is undertaken in conformity with the recognized principles of forest science separately for each subdivision, with regard to differences of ground and forest stand.

7. The description consists of general and stand description.

8. The general description is based in certain parts on stand description, and shall under separate titles account for—

History of the changes which the forest has undergone financially, state and administration of possessory right, wherewith, if practicable, the official proceedings may be introduced on which the changes or improvements have been based, and the influence of these, of forest fires, of injuries by storms and the like on the forest's present condition.

The uses or service with which the forest, from one cause or another, is charged; how far these are based on culture or resolutions, and in the latter case what, also, the influence on the forest which the uses produce.

Boundaries on adjoining stranger owners; also, when the forest belongs to homestead or farm, on the thereto belonging arable and pasture land; wherewith for that case any land which did not before belong to the forest, but which is included in the allotment, with the reason therefor, ought separately to be given, regard being had to what is prescribed in royal forest regulations of the 29th June, 1866, section 38.

Nature of the forest land, nature of the forest stand in general, according to stand description.

Block allotment or dividing, and motives for the same.

Prevailing winds, and their effect.

Depredations and wastes: to what extent the forest is exposed to such, and their nature.

Watching or care; how this is ordered and how far sufficient.

Pasture and autumn-mowing, and what effect such use has on the forest.

Selling of the produce of the forest, where this can come in question, wherewith, when this is dependent on opportunity of floating, a map of the floating course in the forest and in its neighborhood is annexed, providing such map can be had without separate survey.

With several other relations which, in and for the forest administration, can be of weight, which like the above-mentioned ought to be stated under separate titles.

9. *The description of the stand.* Table No. 1, 1, which is prepared in tabular form, and which, with the exception of area reports, composed in proportion to the progress of the survey and valuation, contains the following columns:

1. *Division*, or parcel (in the Swedish "skiften"), wherein is introduced the name of the division, in what block it has been divided, also the letters whereby these are denoted on the map.

2. *Subdivision*, in which column is placed the letter whereby the differences of the forest land and forest stand have been denoted on the map.

3. *Extent*, wherein the area is given in new measuring (quadrat ref and quadrate poles), and which column is subdivided in two, namely:

a. Forest land, where regard is had to the area of forest-bearing ground, the subdivisions are given as—

α. Forest-grown, or—

β. Bare, under which latter designation may be introduced as well such land as produces only bushes and scattered trees as that which shall be cleared, during the division period for effecting satisfactory regrowth; also—

b. Impediments and land not regarded sufficiently fertile for forests, under which is noted such rocky hills, marshes, mosses, etc., which can not be counted on to bear forest; also such sand holes, ways, and tilled places, etc., whereon forest will not be grown.

4. *Land* where under the subdivision is described with regard to the quality of the land and soil.

5. *Situation*, where the situation is described as well with regard to moisture as in relation to prevailing winds.

6. *The forest*, which column is subdivided into four:

a. Sort of trees, wherein is introduced the kind of trees the forest stands consist of, with special remarks as to the prevailing—

b. Growth, closeness, windfalls, previous treatment, etc., where a fuller description of the forest stand is given, as well as how the same seems to have been treated previously.

c. Amount of production, wherein is noted the number of cords, at 100 cubic feet (Swedish) solid measure, which the growing forest contains.

α. By quadrat ref (say 10,000 square feet) in whole and tenths of cords, and—

β. By subdivision in whole cords; or nevertheless with heavy or merchantable timber-thinning number of sticks per 10,000 square feet and in the whole subdivision; also—

d. Age class, wherein is introduced the prevailing ages of the forest

stand, designed to show twenty-year-age classes, from 1–20, 20–40, 40–60 years, etc., whereafter, under the title of *treatment of the stand during the division period* (Tables Nos. 1, 2), follows:

7. *Manner of working the forest*, in which column is noted how far the stand shall proceed under allotment of tract cutting, or if thinning or low-forest culture should be there introduced; and—

8. *Special means*, including accounts of what ought to be adopted for the stand and land during the time for which the division is regarded to be effective, whereto shall be stated for the occurrence of help pruning or preparatory cleaning (or cutting) that amount of wood and timber which thereby, according to valuation, it is considered can be obtained per 10,000 square feet. The area, as well as quantity of wood and timber on the subdivisions may be summed up for every division or parcel, and a compendium introduced at the end of the table, wherein the whole of the area of the division or parcel and quantity of wood and timber noted shows the extent and bulk of the wood and timber, as well as a like compendium for the separate blocks to show the whole area of the forest and stock of wood in cords, or with heavy or merchantable timber thinning in timber.

To the description of the stand belong equally with tract cutting a compendium of the area which the different age classes occupy and the timber and wood mass each one contains. The description ought to be accompanied by the length valuations introduced in the forest.

10. *The plan of management*, of which a sketch ought to be made at the place of employment, so that the state of the forest in case of need may serve for further direction, contains the following titles:

Manner of working the forest, under which is noted for every block how great part of forest land and quantity of wood and timber suits the one or the other of the mentioned methods of working the forest, and where so required the motives for the distribution of the forest ground between them.

Rotation, under which title separately for each block and method of working the forest with necessary motives may be introduced the age which, in general, it is thought the forest should have before the same can be consumed; whereto with heavy timber thinning under the title in question ought to be given the time.

Thinning time, during which thinning shall be done.

Consumption, which title for every block contains a calculation of what, during the whole of the twenty-year period, and during every year of the same, should be consumed; also report where and how consumption ought to be effected separately for forest adapted to tract cutting, thinning, or low forest culture; and there ought therewith to be added in tabular form, equally for the two foregoing titles, a compendium (Table No. 2), to which is added a report for the whole block and area, and amount of wood and timber summed together.

Forest cultivating (with special regard to sowing and planting), under which is noted in table form (Table III), by block division and subdivision, the area of the ground which during the period shall undergo complete forest cultivating (that is, clearing and raising forest again on the same place by planting or sowing), help culture, drainage, or other means for advancing regrowth, whereto may be noted the nature of the measures and steps which, in every case, shall be adopted.

Project for the future division of the forest in respect to rotation and thinning periods, under which title, and with reference to the map of the forest, is indicated how it is considered, on the basis of the present

state, the subdivisions ought to be united for hastening, and with least sacrifice of growth, to form suitable parts of the forest, corresponding with the twenty-year periods, separate report being made for the division of the ground in every block for tract cutting, thinning, or low forest growing.

Pasture and autumn mowing, under which is noted that which, with regard to the subject, should be observed during the division period.

Means of facilitating the transportation and sale of wood and timber, under which title is given, as may happen, the needful scheme for ways, improvement of floating courses, disposing of the sorts of timber necessary for the region, etc.

Administration and care, wherewith representation is made of what, in said respect, ought to be adopted to secure suitability of plan of economy, therewith always complying with what is prescribed by the control book for consumption and forest cultivation.

11. *Rotation with tract cutting* is determined so that, after knowledge is acquired of the kinds of trees the forest will yield, and the growing time required for them, the area of the forest-grown land is divided into the number of twenty-year periods which said growing time contains; thus, with one hundred and forty years' growing time by 7, with one hundred and twenty years by 6, etc., whereby is ascertained the extent on an average can be consumed during every twenty years. Thereafter is examined through comparing the extent of this latter with the area which every age class takes up, how long time consumption in each and every class, beginning with the oldest, should require, wherewith also knowledge is gained of the age of the forest at the time of consumption. If then it is found that any essential part of the forest should be consumed first after that which has taken injury from too high age, so ought said examination to be renewed in a twenty years' shorter time, and in proportion to the therewith greater area of consumption, till its result shows that the forest can be consumed without losing in value when the last-mentioned time is adopted for rotation time.

With the introduction of regulated timber thinning it is seen, too, that the thinning time becomes so sufficient that a requisite number of trees may be able to grow to heavy timber by the time its thinning returns to the same tract which it before went over.

As well rotation as thinning time should contain a certain number of twenty-year periods.

Thinning time ought to be an equal part of rotation time.

12. The computation of what is taken out by tract cutting during the period is made thus:

Of that part of the forest-grown land allotted to tract cutting is assigned for *consumption* during forty years, two-sevenths of the area with one hundred and forty year, two-sixths or one-third with one hundred and twenty year, two-fifths with one hundred year rotation periods, etc. Out of the oldest age classes is taken off thereafter as great area as corresponds to said part. The forest which is found on the area thus taken off consists of that which can be consumed during forty years. Hereof is allotted for consumption during the first twenty years, out of the oldest or least growing stand, so great a part that the growing forest thereon, *without* including the grown, may attain to wood and timber mass equally with the growing forest on the other part, *with* reckoning or including that grown during twenty years. With the reckoning of growth, nevertheless, so-called growth tables

may not be used unless the yearly growth of the stand running in the two-thirds is accepted as the average amount of what these during its filled age yearly grow.

In thinning of heavy timber is consumed, during the time adopted for thinning, all the timber found at the dividing or allotment besides half the quantity of heavy timber stuff which within the period of thinning can grow. Of this amount of wood and timber can thus be consumed during the twenty-year division period, with forty-year thinning time half, with sixty-year one-third, and with eighty-year one-fourth. In this way is taken off that part of the forest which shall correspond with the first twenty-year period, wherewith is observed, nevertheless, that only such land as bears heavy timber, or within the thinning period grows heavy or merchantable timber stuff, enters into the calculation, also that the part taken off does not more than twenty-five per cent exceed that which the land just mentioned, reckoned exclusively according to the area, shall have produced in the period. If it is found, notwithstanding such augmentation in area, the part taken or sold off does not contain the number of pieces of timber which, according to the above-mentioned calculation ought to be had, the consumption is reduced to what the thus sold-off district for a period of twenty years can according to calculation give.

With other thinning the consumption's mass is calculated the same as is mentioned in regard to tract cutting.

In the dividing or allotment for low-forest growing, with separate blocks, the area is divided by that number of periods which the rotation time contains, after which the amount of consumption is fixed according to the bulk of production on that part which corresponds to the first period, wherewith, if so required, the growth is reckoned in the manner above written.

In the consumption calculated in harmony with the above principles is not included what, according to estimate, is obtained through preparatory thinning and help pruning or clearing up of found windfalls and dry forest, so-called cleaning-cutting, likewise neither the utilizing of stumps, roots, branches, and twigs.

13. When the division or allotment takes place in such forests as are mentioned in Chapters III and V of the Government's Forest Regulations of 29th June, 1866, with the dividing proceedings and maps shall special memorial be prepared, representing how far it is thought the forest, according to §§ 16 and 23 of said regulations, ought to be placed under the immediate care and administration of the forest corps, also if such is not the condition, the need of the products of the forest at the homestead or farm to which it belongs; also how far the forest is insufficient to supply said need, or nevertheless besides answering the requirement or leaving something over the same, and in the latter case the amount of surplus, also project for the forest rent, which according to § 17 ought to be reckoned, or that portion of clear gain which, on the principle of § 24 of regulations, can accrue to the resident occupier.

14. At the *revision* of the allotment which here above is ordained is drawn up accurate calculation of the older age classes, wherewith the map is intended for introducing noticed changes.

Revision shall also be had of the forest maps and plans of economy hitherto drawn up for the public forests, where these have been operative twenty years or more. Should the maps and allotment proceedings be found continuing suitable the drawing up of new ones may be dispensed with.

14. Explanation of Certain Terms in Swedish Forest Science.

Forest culture (skogs skötsel) includes the raising of forest, its treatment during growth, and its consumption.

By *consumption* of forest is understood the felling of trees in such a manner as to facilitate the effort of nature to produce new forest in place of the former.

Forest cultivating (skogs odling) is the raising of forest by means of sowing seed by hand or planting.

High forest is that which is not intended to be consumed till the trees have attained their maturity.

Low forest is that which comes from shoots from the roots or stumps of former trees and which may be consumed in a shorter time to give place to another similar crop—as, for instance, timber for hoops, hop poles, and the like.

Rotation period. The time required, commencing with the sowing, for a forest to grow and mature.

Tract cutting is the felling of such a portion of the forest as, according to a previously prepared plan, has been allotted for a year's supply, or such a portion as can be cut with due regard to the rotation period.

Regulated thinning is a manner of consumption or of cutting which is generally practiced in forests where the trees in the same place are of different age.

C. C. Andrews.

St. Paul, Minn., *June 19, 1900.*

O